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**APV**

*a major advance in evaporation and concentration techniques*

**plate evaporators**  
**essence recovery systems**  
**heat exchangers**

for  
MILK  
FRUIT JUICES  
WORT  
BROTH (MEAT)  
GLUCOSE  
TEA  
COFFEE  
HEAT SENSITIVE FOOD  
AND CHEMICAL PRODUCTS

# greater efficiency in processing heat-sensitive

Since its introduction in 1957, the A.P.V. Plate Evaporator has had a rapid acceptance in 37 countries, concentrating a wide variety of dairy, fruit, meat, chemical and other heat-sensitive products.

The unique feature of the A.P.V. Plate Evaporator is its ability to maintain product quality. This is the result of the single-pass rising and falling film principle utilizing an arrangement of gasket-sealed plates instead of the usual tubular calandria. Unlike the ordinary circulation type evaporator, the A.P.V. has a very low liquid hold-up . . . so that the liquid is in contact with the heating

surface for a very short time. This is an important advantage in processing heat-sensitive liquids.

Low liquid hold-up permits any quantities of feed to be processed with rapid start-up at equal efficiency.

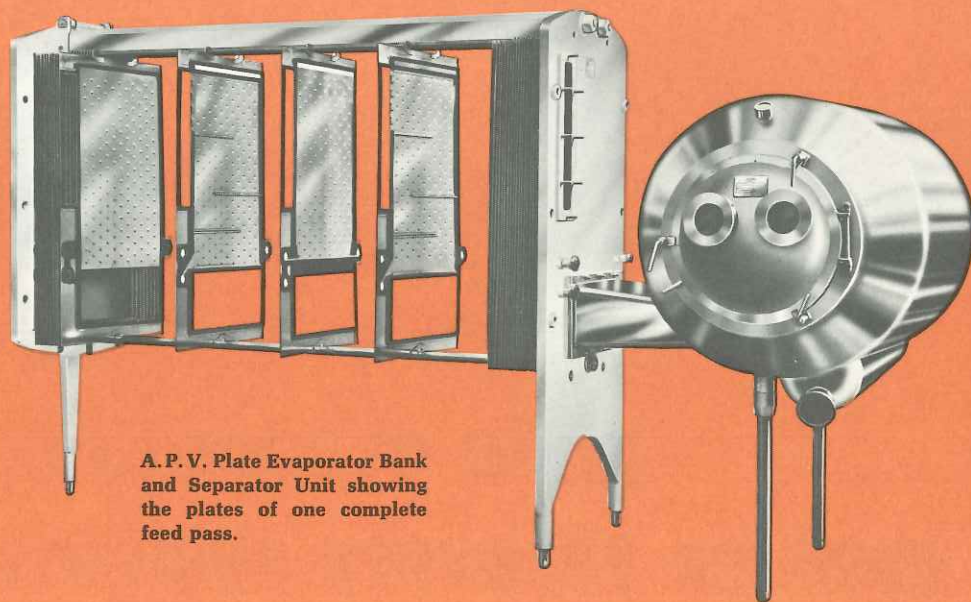
Operation is extremely simple requiring only two manual controls. An automatic float valve controls the liquid level while a micro-meter valve accurately maintains product concentration. Once steam and feed rates are set, operation is practically automatic. Any manual control required can be done at the floor level.

**APV**

## PLATE EVAPORATOR

*The following materials have been processed successfully in the A.P.V. Plate Evaporator:*

Skim Milk and Whole Milk	Strawberry Juice
Whey	Apple Pectin
Sweetened Skim Condensed Milk	Chicken Broth
Sweetened Full Cream Condensed Milk	Corn Steep Liquor
Buttermilk	Enzyme Solution
Orange Juice	Fish Stick Liquor
Grapefruit Juice	Gelatin
Apple Juice	Glucose
Pear Juice	Hydrolized Protein
Grape Juice	Jelly
Black Currant Juice	Malt Extract
Pineapple Juice	Meat Extract
Lime Juice	Sucrose
Cherry Juice	Gelatin Desserts
Raspberry Juice	Wort
	Coffee Extract
	Tea Extract



A.P.V. Plate Evaporator Bank and Separator Unit showing the plates of one complete feed pass.



# products

The A.P.V. Evaporator is extremely compact and flexible in design. Individual plate construction provides extreme flexibility to meet varying demands of capacity and function. Plates can be quickly added or removed to change capacity. All surfaces in contact with the product are stainless steel and fully accessible for inspection and cleaning. The unit can be easily cleaned in place with low pressure steam or detergent solution.

All of these features of design and performance establish the A.P.V. Plate Evaporator as a major advance in evaporation technique.

## *advantages of the A. P. V. plate evaporator to the product*

- Retains all natural characteristics of the original feed.
- Concentrated fruit juice has less tendency to spoil. Eliminates need for low temperature storage.
- Improves solubility of powdered instant milk products.
- Reduces storage space and cost of transportation.

## *to the user*

- Insures a superior product.
- No off-flavor or cooked taste.
- Economy of operation.
- Simple to operate and control.
- Stainless steel construction eliminates product contamination.
- Unique single-pass operation makes possible higher product strength without loss of quality. Malt extracts, glucose, and sucrose can be concentrated beyond 80%.

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## *typical applications*

### **DUFFY-MOTT COMPANY**

The A.P.V. unit replaced an existing tubular vacuum pan. It provides concentrated apple juice from 11.5° Brix to 72° Brix, with a feed rate of 10,700 lbs/hr. and evaporation of 9000 lbs/hr. without any off-flavor or cooked taste. Concentrate can be easily reconstituted, enabling Duffy-Mott to increase production with less storage requirements; buy apples when prices are lowest and economically store surplus juice instead of diverting it to vinegar.

### **LAND O'LAKES CREAMERIES AT MOUNTAIN LAKES, MINN.**

A.P.V. Double Effect Evaporator, with duplex plate and frame unit with each Separator, processes 28,000 lbs/hr. of 8.5% solids skim milk, evaporating 22,300 lbs./hr. to produce 5700 lbs./hr. of 50% solids concentrate. This is used for production of premium grade low heat instant milk powder by spray drying on a 20-hour work day. Normally, this capacity would require vertical separators but A.P.V. design and flexibility made horizontal separators possible which easily fit the low headroom.

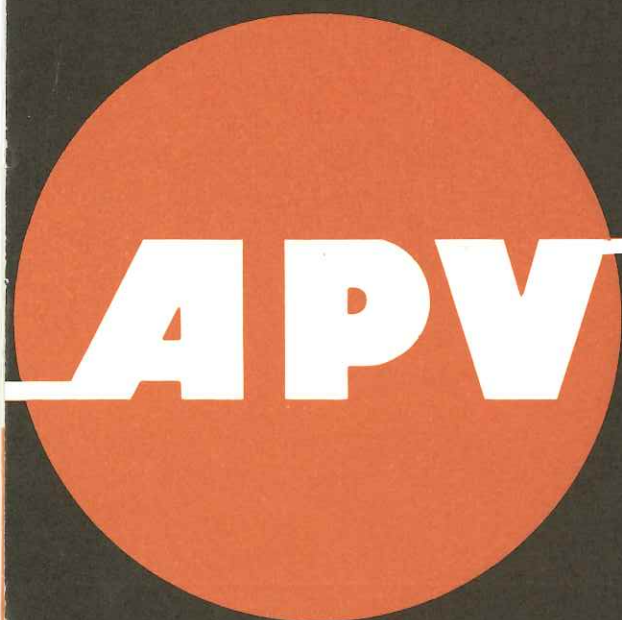
### **SUNKIST LEMON PRODUCTS DIVISION**

A.P.V. Double Effect Plate Evaporator with thermo compression met the requirements for increased capacity, good characteristics of a low temperature concentrate and low production cost. This A.P.V. unit evaporates 15,400 lbs/hr. of 8% solids lemon juice to 50% solids. Color and flavor met the high standards of quality. The unit operated with increased steam and water economy and considerably less operating labor. The unit was later increased in capacity by 100%. The inherently flexible design of A.P.V. equipment permitted the change of the Double Effect Evaporator to triple effect operation by a simple redistribution of the plates. Heat duty of each of the new sections was easily balanced. Steam consumption was minimized by preheating the feed with condensate using an A.P.V. spray-condenser heater.

### **BROWN & POLSON CO., LTD.**

A Double Effect plant concentrates glucose from 48% total solids to 74.4% solids. This material is subsequently concentrated to 85.4% in a finishing effect. Feed rate is 12,700 lbs./hr. with a product rate of 8,240 lbs./hr. The finished product rate is 7,190 lbs./hr.





The Plate Evaporator differs from a conventional unit in that the tubular calandria is replaced by a compact arrangement of gasket-sealed plates held together in a frame. The plates are assembled into units to suit the evaporating duty required.

Feed liquid enters the base of the inlet section and vaporizes on contact with the heated plate. It rises to the top and passes to the adjacent falling film section where vaporization continues. The evaporation is completed within two adjacent plates in a few seconds to provide minimum liquid hold-up and contact time. The concentrated product and its vapor are discharged into a cyclone separator where the product is removed while the vapor goes to a condenser or other next effect. Steam condensate can be used to preheat the feed before it is returned to the boiler.

The Plate Evaporator may be arranged as a single or multiple effect unit with or without vapor recompression, or vapor preheating, to achieve maximum steam economy.

**PLANT CONTROL** is simple requiring only two variables . . . for steam and inter-effect product flow. Operating conditions can be indicated on a central instrument panel.

**RAPID START-UP** requires only the adjustment of steam supply to establish vaporization rate and regulation of liquid flow with the calibrated feed valve. The calibrated valve permits former operating conditions to be exactly duplicated. Concentrate draw-off from the first effect automatically governs raw liquid feed.

**HIGH CONCENTRATIONS** may require some recirculation in the final effect. Where a very high degree of concentration is required, a separate finishing stage is supplied which simplifies operation.

**SHUTDOWN AND CLEANING** is rapid and simple. Low liquid hold-up minimizes waste. Without disassembly, the unit is flushed with a detergent solution followed by a clean water rinse. When required, the entire unit can be opened in minutes for inspection.

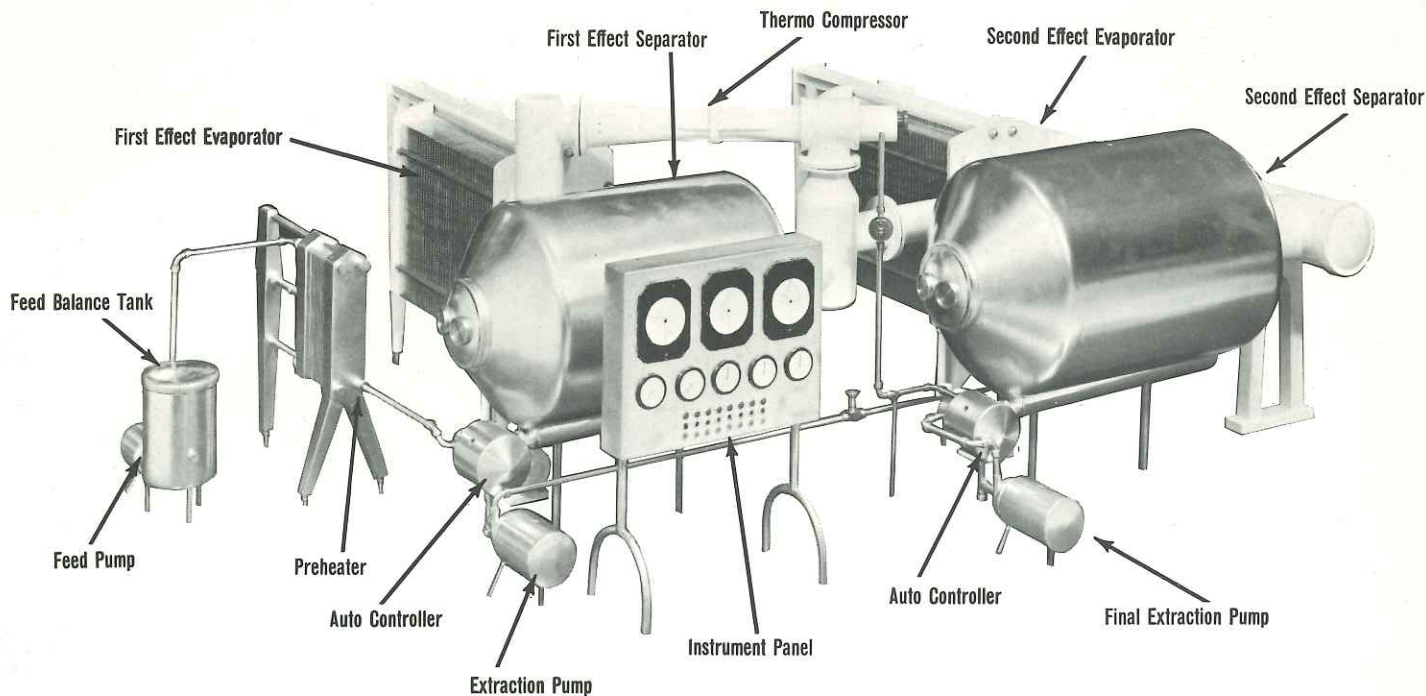
**ADJUSTABLE CAPACITY.** The use of individual standard plates allows increase or reduction of capacity by changing the number of plates in the evaporator unit. Since individual plates can be easily redistributed, design of existing equipment can be conveniently changed and the heat transfer in various effects adjusted to compensate for changes in duty.

**CONSTRUCTIONAL MATERIALS.** All parts of the A.P.V. Plate Evaporator in contact with the product are stainless steel. Other materials can be used, depending on the nature of the liquid to be concentrated. The plate frame is finished in a sanitary enamel.

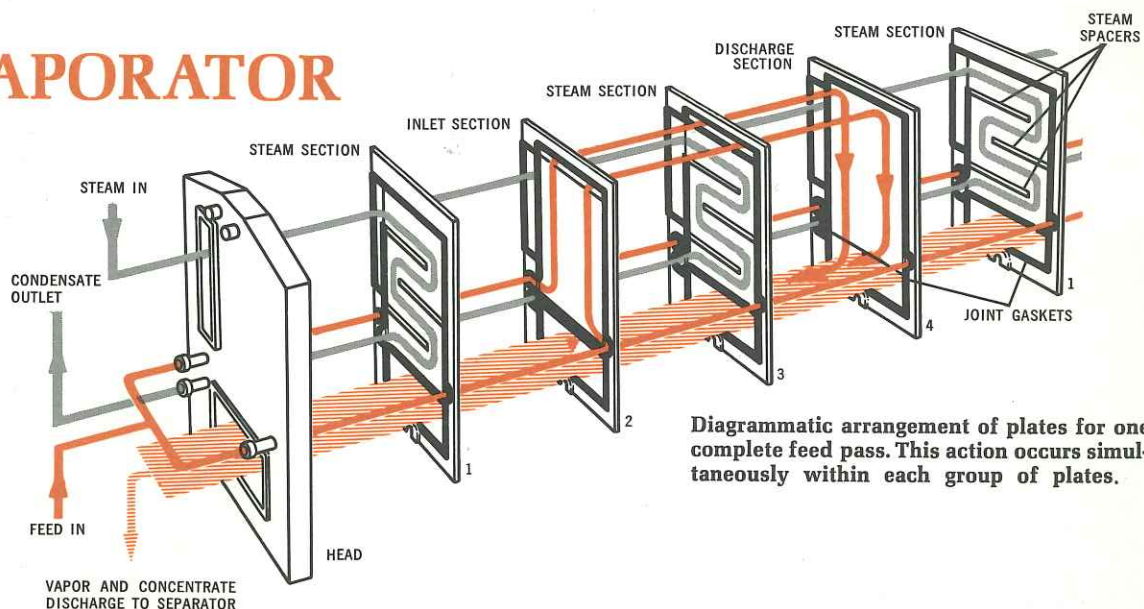
**MAXIMUM CAPACITY.** The maximum capacity obtainable depends on the materials handled and the temperature requirements. Up to 50,000 lbs./hr. evaporation can be obtained under suitable conditions.

**REDUCING STEAM CONSUMPTION.** Normally, multiple effect evaporators provide the greatest degree of steam efficiency. In certain cases, steam consumption can be reduced by the use of thermo-compression of the first effect vapors. Steam demand can thereby be reduced from approximately  $\frac{1}{2}$  lb. of steam per lb. of water for normal two-effect operation to  $\frac{1}{3}$  lb. In addition, evaporator vapors or condensate of any type can be used to preheat feed liquids. The highly flexible design of A.P.V. equipment is well suited to this steam economy. The wide experience of A.P.V. engineers and the application of these techniques can add considerably to operating economy.

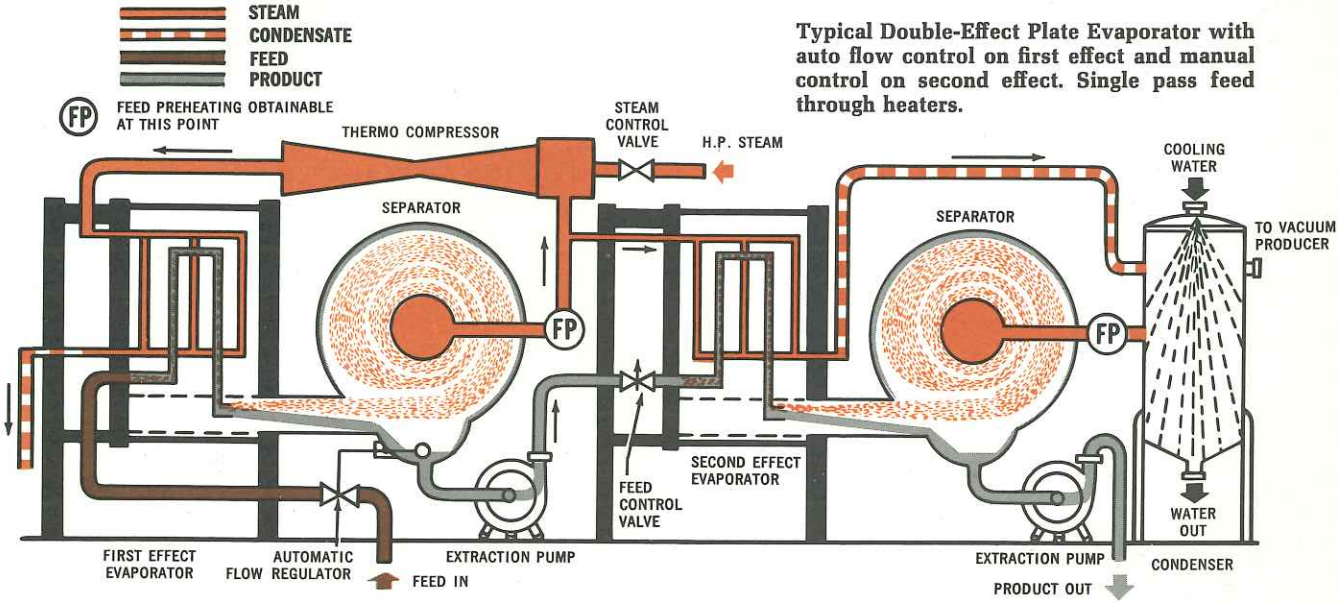




# PLATE EVAPORATOR

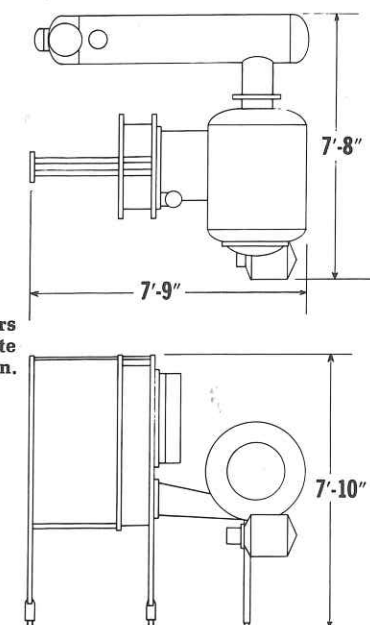


Diagrammatic arrangement of plates for one complete feed pass. This action occurs simultaneously within each group of plates.

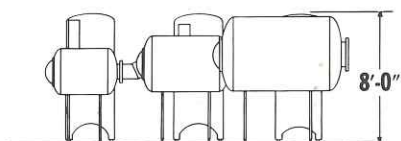
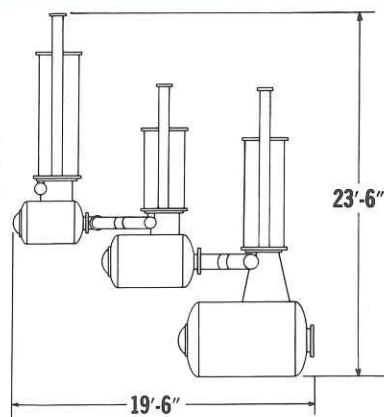


Typical Double-Effect Plate Evaporator with auto flow control on first effect and manual control on second effect. Single pass feed through heaters.

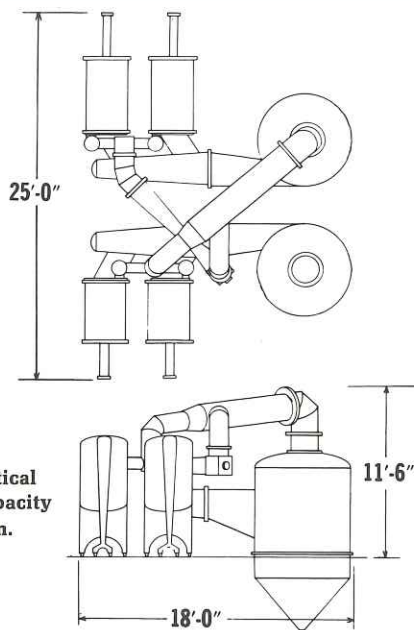
Single effect with horizontal separators and surface condenser. Approximate capacity 3,000 lb./hr. of evaporation.



Triple effect with horizontal separators. Approximate capacity 20,000 lb./hr. of evaporation.



Double effect with thermocompressor using duplex frames and vertical separators. Approximate capacity 30,000 lb./hr. of evaporation.



## auxiliary and optional equipment

**CONDENSERS AND VACUUM PRODUCER.** Either surface or direct contact spray-type are normally supplied depending on the type of water supply available. Steam ejectors or mechanical vacuum pumps are most commonly used.

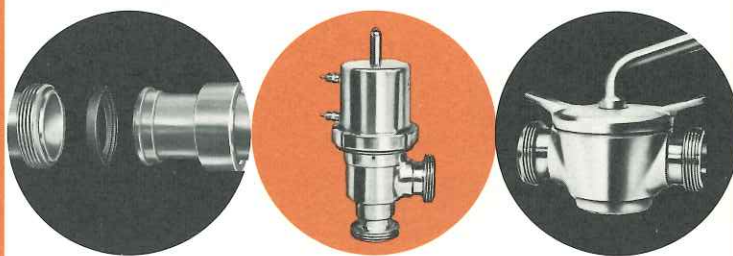
**BALANCE TANK** permits more accurate control of flow from the feed storage tank. It also simplifies the preparation and circulation of cleaning solutions.

**PUMPS** A.P.V. S.S. Puma Pumps with water-cooled seals are normally supplied for all liquid transfer. Their sanitary design simplifies dismantling and cleaning. Rotary positive pumps are used for extremely viscous materials.

**INSTRUMENTATION.** An instrument panel can be provided to incorporate all process gauges and controls in one central location.

**CONCENTRATION MEASUREMENT.** The product is passed through a pipeline refractometer or a by-pass hydrometer to continuously measure concentration. Automatic density control system can also be provided.

**STAINLESS STEEL C.I.P. FITTINGS.** A.P.V. C.I.P. fittings are designed specifically for clean-in-place lines. They fill the need for sanitary lines, effectively and economically. Available in 1", 1½", 2", 2½", and 3" sizes.



**PNEUMATIC VALVES.** A.P.V. Zephyr air-operated stainless steel sanitary valves for automatic and remote control operation are designed for in-place cleaning. Available in 1½", 2", 2½", and 3" sizes.

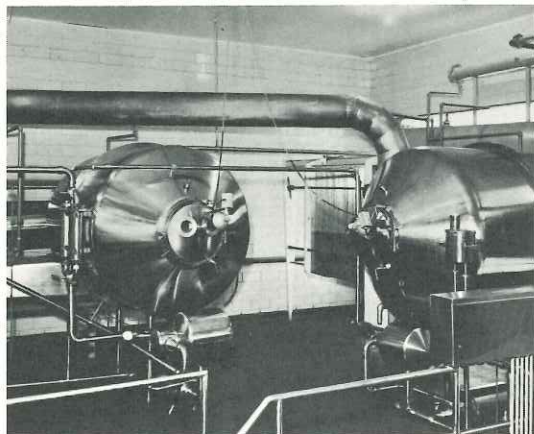
**WIDE ANGLE VALVES.** The A.P.V. Wide Angle stainless steel sanitary Plug Valve is new in design and construction. Eliminates sticking, galling, and leaking. Available in 1½", 2", 2½" and 3" sizes.

Because of the extremely flexible character of A.P.V. equipment, layouts can be arranged to fit virtually any space configuration.

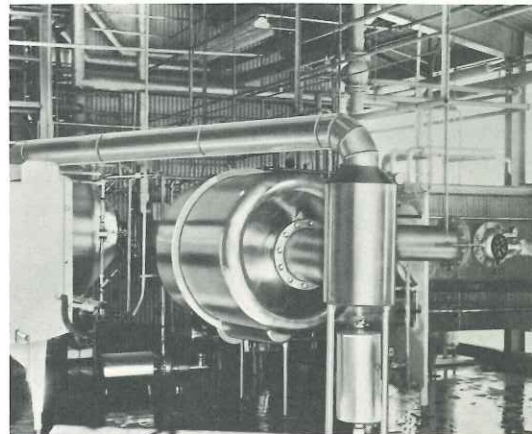


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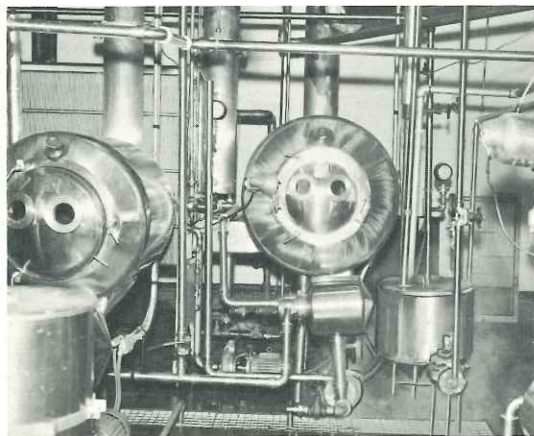
## typical installations



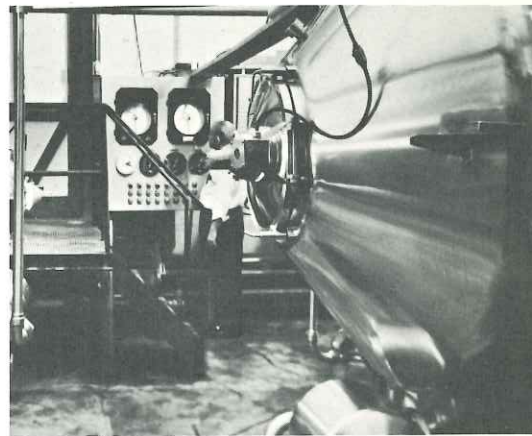
(left) Spring Valley Co-Op Creamery Co., Spring Valley, Minn. Evaporating 20,000 lbs/hr. skim milk from 8.5% to 45% total solids.



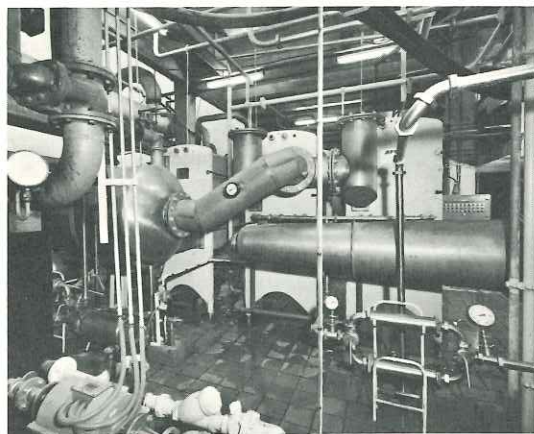
(right) Sunkist Lemon Products Division, Corona, Calif. Evaporating 15,400 lbs/hr. 8% lemon juice to 50% concentrate.



(left) Welch Grape Juice Co., one of three similar concentration and essence recovery plants located in Westfield, New York, Brocton, New York, and Lawton, Michigan.



(right) Duffy-Mott Co., Inc., Holley, New York. Concentrating apple juice from 11.5° Brix to 72° Brix. Feed rate 10,700 lbs/hr., evaporation 9000 lbs/hr.

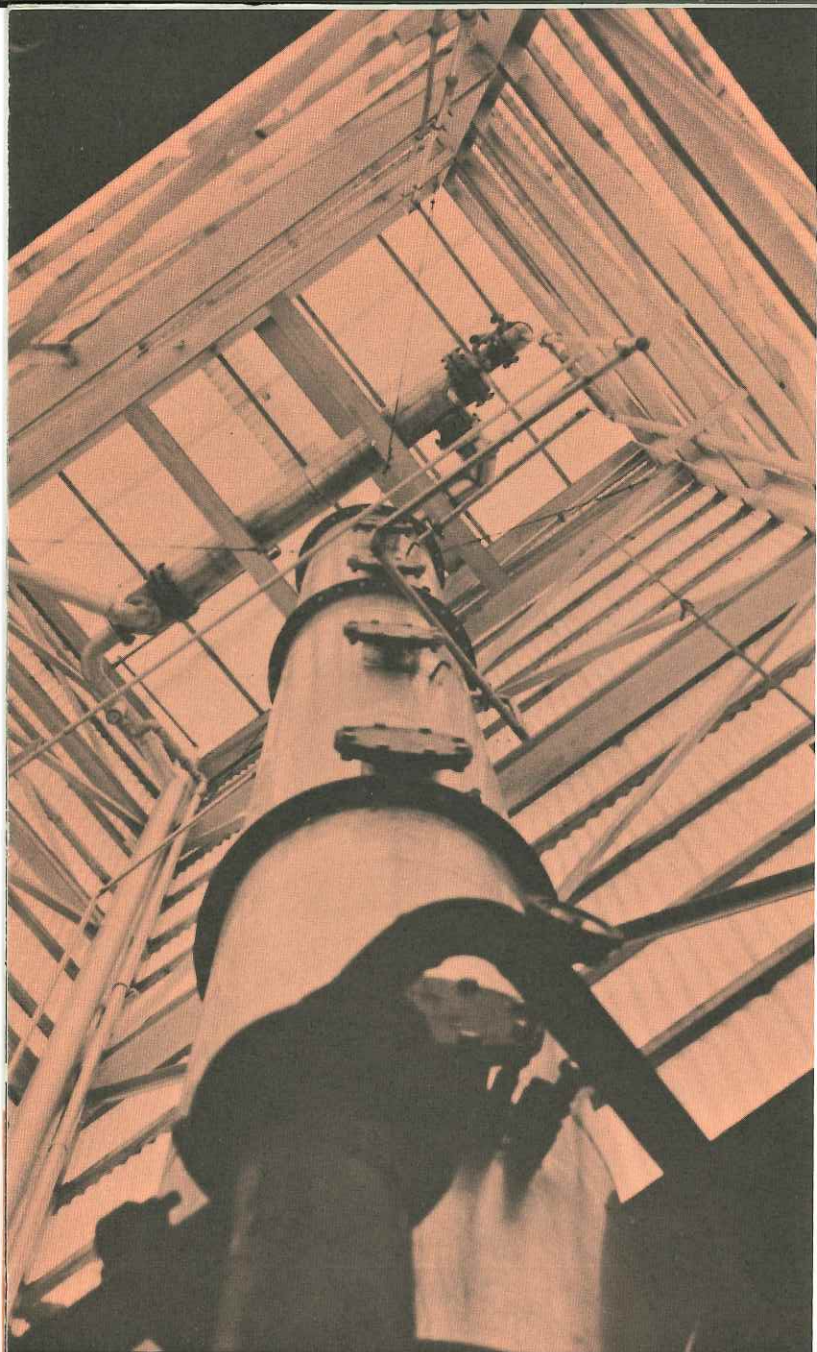


(left) Brown & Polson Co., Ltd. Triple effect plant concentrating corn steep liquor from 6.14% total solids to 55% total solids at a feed rate of 24,600 lbs/hr.



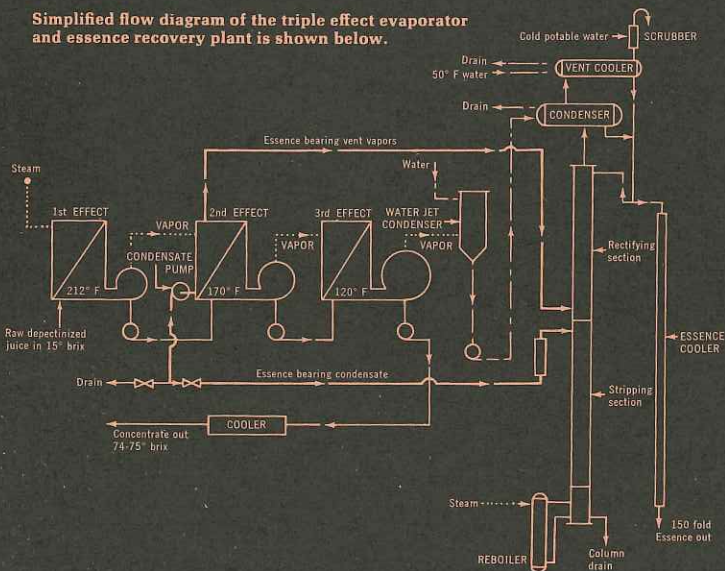
(right) Land O' Lakes Creameries, Inc., Mountain Lake, Minn. Evaporating 28,000 lbs./hr. 8.5% skim milk to 50% solids.





The Distillation Tower of the Essence Recovery System of the Michigan Wineries, Inc. is installed in a fiberglass penthouse. It is located at their Paw Paw Grape Juice Plant, Paw Paw, Michigan.

Simplified flow diagram of the triple effect evaporator and essence recovery plant is shown below.



Fruit juices lose much of their natural flavor and aroma during an evaporation process. In the citrus industry, this flavor is collected and returned to the concentrate to maintain product quality. With apple, grape and other juices, the method normally used is to "strip" the feed juices of their flavor by evaporation and to "concentrate" these esters in a distillation column. This flavor essence can then be added back to the concentrate to maintain original natural flavor and aroma.

The esters of different fruits may vary in their properties; different percentages of vaporization or stripping are required, and the subsequent distillation process must be geared to the particular properties of the fruit. With apple, pear, strawberry, and berry juices, a strip of 10% is sufficient as they contain highly volatile esters.

Concord grape juices are more difficult. The natural "tangy" flavor of Concord juice is largely due to a constituent called "Methyl Anthranilate," which boils at a high temperature and is, therefore, not very volatile. It is

## fruit juice concentrati

necessary to strip between 25-30% of the incoming juice, and even then, only about 50% of the Methyl Anthranilate is boiled off. More will be boiled off and lost in subsequent evaporation stages but the concentrate will still contain perhaps 15% of the original Methyl Anthranilate. Distillation is relatively difficult on account of its low volatility.

### Grape essence recovery

Usually these juices are concentrated in a single effect "stripping" evaporator, followed by a main evaporator operating as a double effect unit. The essence bearing vapors from the first effect are led to a distillation column where the essence is concentrated. Such a column is called a vapor feed column.

Although this system is commonly used today, it has one disadvantage in poor steam economy.



**The A.P.V. Liquid Feed System.** The main evaporator is arranged as a straight Triple Effect evaporator. Such a unit gives economy equal to the Double Effect with Thermo-compression, but does not need the high-pressure steam seldom available in juice plants. The first effect of this evaporator will automatically evaporate a little over 25% of the incoming juice and, in effect, becomes a "stripping" evaporator. The vapor from this effect goes to the stainless steel steam chest of the second effect where its available heat is recovered as it is condensed. The weak essence condensate is fed to the liquid feed column. Since all of the effects are stainless steel, there is no possibility of product contamination when the essence bearing vapor from the first effect gives up its heat in the second effect.

In other respects, this system is similar to a vapor column design, but provides the following advantages:

**1. Steam Economy.**

**Apple Juice — Traditional Method**  
(assume 12,000 lbs/hr. feed)

Single effect stripping evaporator	lbs./hr.
10% .....	1200
Evaporation remaining, 8,800; take double effect .....	4000
Total Steam .....	5200*
*Plus Steam to reboiler	

**Apple Juice — A.P.V. Method**

Triple effect evaporator .....	3200
Steam to base of column .....	720
Total Steam .....	3920

**Concord Grape Juice —  
Traditional Method**

(assume 15,000 feed, 12,000 evap.)	
30% stripping evaporator .....	4500
Double Effect for remaining 7,500 evap. ....	3500
Total .....	8000*
*Plus Steam to reboiler	

**Concord Grape Juice — A.P.V. Method**

Triple Effect Evaporator .....	3800
Steam to base of column .....	2400
Total .....	6200

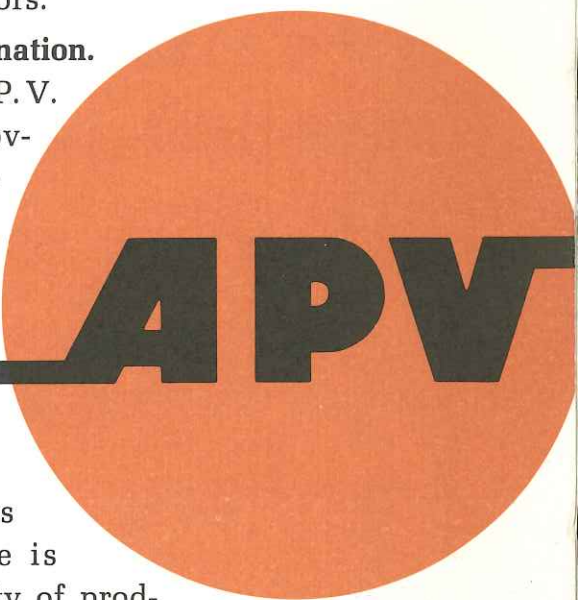
*In Addition:*

- Operational.** The essence column operation is isolated from the evaporation process. Consequently, the column can be left on "boil up" even when the evaporator is not operating or when it is being cleaned. There is no danger of contaminating the column with cleaning compounds.
- Column Costs.** These are reduced, particularly in the case of Concord Grape Juice.
- Concord Grape Juice.** A much higher recovery of Methyl Anthranilate is possible.
- Water Consumption.** Water requirements are reduced by using the main evaporator cooling water for condensing the essence column vapors.
- No Contamination.** Since all A.P.V. essence recovery equipment is constructed

entirely of stainless steel, there is no possibility of product contamination even though various product streams contact both sides of heat exchange surfaces.

**A.P.V. equipment, because of its highly flexible design, is ideally suited to the varied requirements of juice concentration and flavor recovery. A.P.V.'s wide experience in the field is available to food processors to assist in the design of plants to provide superior products at lower cost. Today, superior quality is essential to maintain customer appeal and increase sales. Why not look into improved process techniques using A.P.V. methods.**

**on and essence recovery**





The newly introduced A. P. V. "JUNIOR" PLATE EVAPORATOR offers, for the first time, a truly versatile small size evaporator specifically designed for Pilot Plant operation, Development Laboratories, and small capacity Production Lines.

It is a continuous steam operated evaporator, employing the proven plate heat exchanger principle, with short heat contact times and low hold-up volumes. It is available in either single or multiple effect design and suitable for a wide variety of products.

**DESIGN FEATURES** include all the advantages of the full size A. P. V. Plate Evaporator; among them are —

1. Variable evaporating surface for different capacities and products.
2. Selection of separators and auxiliaries such as condenser and vacuum producer to suit individual requirements.
3. Stainless steel, sanitary, clean-in-place construction.
4. Compact, pre-assembled package unit.

This Evaporator package is entirely self-contained and is available on a liberal rental plan or outright purchase.

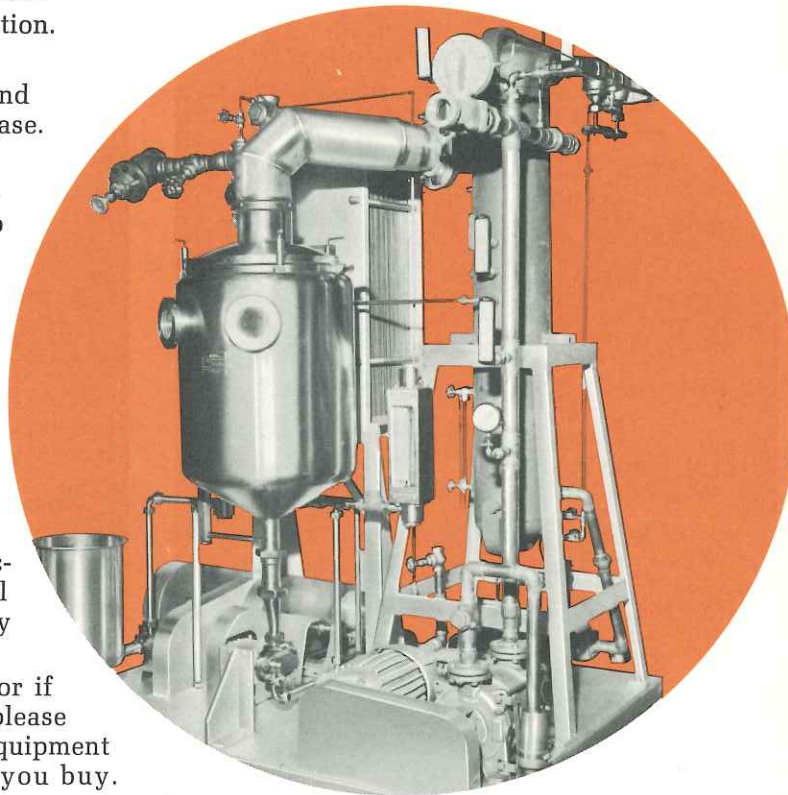
It can be shipped to your plant, connected to your lines, and be ready for a trial run in just a few hours.

If rented, you may operate it for as long as it takes to make comparison tests for economy, product quality, ease of cleaning or other factors. Our engineers will be glad to assist you.

## APV pilot plant for process evaluation

After the completion of a pilot run, you will know exactly what you can expect from an A. P. V. Production Installation . . . concentrate quality, operational economy, simplicity, and speed of cleaning and many more features.

If you are interested in improving your product or if you are considering new evaporator equipment, please write us, so that arrangements for making this equipment available to you can be completed. Try before you buy.



EVAPORATOR TYPE	18J	22J
Capacity (Evaporation) lbs./hr. *	100-400	400-800
Service Requirements (Approx.)		
Steam lbs./hr.	400	800
Water GPM 50° F	16	32
70° F	27	54
80° F	40	80
Electrical (HP installed)	9	9
Space	5' x 5'6" x 8' high	

\*Double Effect, up to 1600 lbs/hr.

\*Triple Effect, up to 1800 lbs/hr.

### Equipment Supplied

1. Mild steel base, painted, on which all components are mounted and assembled. Base has ball feet.
2. Evaporator unit comprising plate bank and frame and vapor/liquid separator. Product surfaces in 18-8 stainless.
3. Product pump, stainless steel positive type with variable speed control.
4. Vapor ducting to condenser.
5. Condenser of surface type, with mild steel shell and brass tubes.
6. Mechanical vacuum pump and vacuum controller.
7. Condensate piping and pump.
8. Steam pressure relief valve.
9. Necessary vacuum gages and thermometers.
10. Feed pump.
11. Balance tank.
12. Steam pressure control valve.



A.P.V. Paraflow Heat Exchanger is a highly efficient continuous heat transfer unit with surfaces which are easily accessible for cleaning and inspection. Their all stainless steel construction combined with rapid thru-put and minimum hold-up offer many advantages over conventional heat exchanger, for a wide variety of application, especially for liquid food products that tend to produce deposits or are heat sensitive. The outstanding features of the A.P.V. Paraflow Heat Exchangers have resulted in their acceptance as standard equipment in the food and juice industries where heating, cooling, pasteurizing and sterilizing of all type of processed liquid foods and juices must be carried out under very sanitary conditions.

Another exclusive feature of the Paraflow is its great flexibility, for not only can its capacity be varied to meet changing needs, but a number of duties can be combined within one frame. From a basic range of standard frames utilizing many sizes of plates, A. P. V. Paraflows can be made up from standard components to meet any requirement and capacity. Connections may be 3A standard, A. P. V. type I. S. S. or suited to customer piping.



## **APV** paraflow plate heat exchanger

### **WHY MORE FOOD AND JUICE PROCESSORS USE PARAFLOWS**

**Extremely High Heat Transfer Efficiency.** Heat transfer co-efficients of 700/800 BTU's/sq. ft./hr./°F. are easily obtainable resulting in very rapid heating and cooling.

Liquids can be heated or cooled to within 2°F of cooling water or heating medium temperature.

Substantial savings in heat and refrigeration are possible since regeneration obtained may be as high as 90% recovery. This means that up to 90% of the heat in a continuous process can be used over and over again.

**Maximum Protection of Flavor and Quality.** Rapid heating with hot water only a few degrees hotter than pasteurizing temperatures. No chance of damaging heat sensitive products. Heat exposure is reduced to seconds with minimum liquid hold-up.

**High Viscosity Liquids Easily Handled.** As many plates as necessary can be arranged in parallel to accommodate very viscous products at reasonable pressure drops.

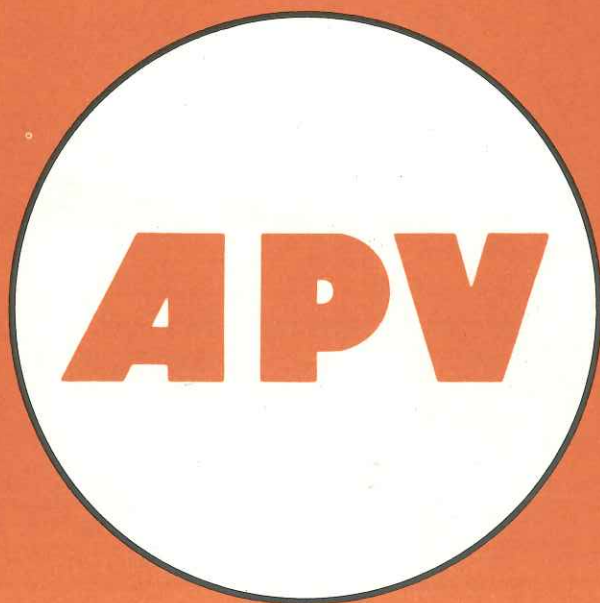
**Compact and Rugged Construction.** Operating pressures range from 60 psi to 225 psi depending upon model selected. Units available in stainless steel frames and low cost painted mild steel frames.

Standard contact surfaces are 18-8 stainless steel.

**Varied Heating and Cooling Cycles in a Single Frame.** Any desired combination of heating, cooling, or regeneration may be performed in a single frame by using special plates (connector plate) to separate the unit into sections.

**Capacities or Temperature Duties Readily Changed.** Flow rates ranging from 1 GPM to 800 GPM depending upon model selected. Capacities or temperature duties may be changed by simply re-arranging or adding plates.





**A**dvanced engineering **P**erformance-proved products **V**alue beyond price

ENGINEERING SERVICE. Each installation is custom engineered to meet the specific requirements of the processors. A.P.V. engineers are specialists in supplying experience-engineered pasteurization and concentration equipment for all food, juice, and heat-sensitive products. ■ Complete surveys of your plant by highly qualified A.P.V. engineers are available for recommendations of the type of equipment to best meet your product and production requirements. ■ Let us show you what A.P.V. can do for you in product improvement and reduction in processing costs. ■ Sales offices are located throughout the country to serve you. For the location of the one nearest you, write, wire, or phone.

**A. P. V. COMPANY, INCORPORATED**

137 Arthur Street, Buffalo, New York 14207 ■ Telephone: 716 876-8744

**A. P. V. (CANADA) EQUIPMENT LIMITED**

103 Rivalda Road, Weston, Ontario ■ Telephone: 416 247-7477